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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/660,635	09/13/2000	Alan Lawrence Higgins	D-ACD-W019 HIGGINS	7304

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EXAMINER	
WOZNIAK, JAMES S	
ART UNIT	**PAPER NUMBER**
2655	3

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/660,635	HIGGINS ET AL.	
	Examiner	Art Unit	
	James S. Wozniak	2655	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *13 September 2000*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-17* is/are pending in the application.

4a) Of the above claim(s) *1-5* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *6-17* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☒ Claim(s) *1-5* are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *9/13/2000* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date 2.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

Detailed Action

Election/Restrictions

1. Restriction to one of the following inventions is required under 35 U.S.C. 121:

I. **Claims 1-5**, drawn to a method of dimensionality reduction by computing a matrix inverse and eigen functions to process speech, classified in class 704, subclass 206.

II. **Claims 6-17**, drawn to a method of speaker verification through fixed-dimension speech feature comparison, classified in class 704, subclass 250.

2. Inventions 1 and 2 are related as a product and process of use. The inventions can be shown to be distinct if either or both of the following can be shown: (1) the process for using the product as claimed can be practiced with another materially different product or (2) the product as claimed can be used in a materially different process of using that product (MPEP § 806.05(h)). In the instant case: Invention 1 can be used for other purposes such as speech recognition and coding, while Invention 2 can be implemented using other methods of dimensionality reduction.

3. Because these inventions are distinct for the reasons given above and have acquired a separate status in the art as shown by their different classification, restriction for examination purposes as indicated is proper.

4. During a telephone conversation with Arthur Plevy on 2/3/04, a provisional election was made with traverse to prosecute invention 2, claims 6-17. Affirmation of this election must be

made by applicant in replying to this Office action. Claims 1-5 are withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to a non-elected invention.

5. Thus, **Claims 1-5** are withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected Invention 1.

Claim Objections

6. Claims 7 and 14 are objected to because of the following informalities: "Baum-Welsh" should be corrected to read --Baum-Welch--. Appropriate correction is required.

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

8. **Claims 6-9** are rejected under 35 U.S.C. 103(a) as being unpatentable over Vysotsky et al *(U.S. Patent: 5,832,063)* in view of Kuhn et al *(U.S. Patent: 6,343,267)*.

With respect to **Claim 6,** Vysotsky discloses:

In a method of automatically verifying a speaker as matching a claimed identity wherein enrollment speech data of a known speaker is compared with test data, including the steps of processing spoken input enrollment speech data and test speech data into speech signals into

series of frames of digital data representing the input speech, analyzing the speech frames by a speaker verification module which compares the enrollment and test features and generates respective match scores therefrom, and determining whether the test speech corresponds with the enrollment speech based upon the match scores, the improvement wherein:

The step of processing the spoken input enrollment and test speech data includes performing a feature extraction process on the enrollment and test speech data *(feature extraction, Col. 7, Lines 38-45)*; and

The step of analyzing the speech frames by comparison includes computing a weighted Euclidean distance between the feature vectors by a discriminative analysis *(Euclidean distance used in speech recognition, Col. 8, Lines 44-47, and discriminative analysis of feature vectors, Col. 11, Lines 58-63)*.

Vysotsky does not specifically teach the ability to convert variable input to fixed-length feature vectors that are independent of the order of words spoken or the speaking rate, however Kuhn discloses:

Ability to convert variable input to fixed-length feature vectors *(dimensionality reduction, Col. 6, Lines 62-64, and Col. 7, Lines 23-26)* that are independent of the order of words spoken or the speaking rate *(adaptive speaker models in the form of a supervector that is fully populated with parameter values for recognizing speech, thus word order would not be important since all parameter values would be contained within the Eigenspace, Col. 9, Lines 41-51. Also, using a maximum likelihood technique, a supervector is selected which is most consistent with input speech, Col. 9, Lines 4-13, so that, regardless of the rate of speech, a*

proper supervector would be selected for speaker and speech recognition. Furthermore, using singular value decomposition the supervector dimensionality is reduced, Col. 6, Lines 36-45).

Vysotsky and Kuhn are analogous art because they are from a similar field of endeavor in speech and speaker recognition. Thus, it would have been obvious to a person of ordinary skill in the art, at the time of invention, to combine the use of a supervector containing all speech parameter values within an Eigenspace for speaker adaptation as taught by Kuhn with the speaker verification method through feature extraction and the computation of Euclidean distances between feature vectors as taught by Vysotsky to provide for adaptive speaker recognition if speech rate is altered, especially in the enrollment process since all speakers do not speak at the same rate of speed, or if the order of words has been altered, for example, if the order of numbers within a voice password is changed . Therefore, it would have been obvious to combine Kuhn with Vysotsky for the benefit of obtaining a method of adaptive speaker recognition capable of detecting speech regardless of speech rate or word order, to obtain the invention as specified in Claim 6.

With respect to **Claim 7**, Vysotsky teaches speaker verification through feature extraction and computing Euclidean distances between feature vectors as applied to Claim 6, which also utilizes a method of HMM adaptation through a Gaussian estimation *(Col. 8, Lines 40-43).* Vysotsky does not specifically further suggest that the aforementioned method of Gaussian estimation utilizing a Baum-Welch algorithm, however it would have been obvious to one of ordinary skill in the art, at the time of invention, to specifically utilize a Baum-Welch algorithm for HMM parameter adaptation since it is a well-known and common means of HMM parameter estimation in the art of speech recognition and has readily available software.

With respect to **Claim 8**, Vysotsky further recites:

The predetermined number of vocabulary words comprises five words, namely, "four", "six", "seven", "nine", and "ti" *(voice password for user verification as a string of digits comprising a word, Col. 11, Lines 45-55).*

It also would have been obvious to one of ordinary skill in the art, at the time of invention that a model set (vocabulary) relating to a digit string voice password would contain four, six seven, nine, and in the case of a password such as "470" or "four seventy", ti, since a password-based speaker verification system would commonly utilize number-related vocabulary words in order to recognize numbers in a password sequence.

With respect to **Claim 9**, Vysotsky teaches the method of speaker verification through feature extraction and computing Euclidean distances between feature vectors, which also utilizes a method of HMM adaptation through a Gaussian estimation and contains a vocabulary corresponding to digits in a numerical password as applied to Claim 8. Vysotsky does not specifically further suggest a feature vector as a concatenation of state mean vectors as recited in Claim 9, however it would have been obvious to one of ordinary skill in the art, at the time of invention, to concatenate the mean vectors of the adapted HMMs in order to create a feature vector related to an entire password sequence for speaker verification which can provide instant recognition of an entire password at once, instead of recognition of individual password digits in sequence.

9. **Claims 10-17** are rejected under 35 U.S.C. 103(a) as being unpatentable over Vysotsky et al.

With respect to **Claim 10**, Vysotsky discloses:

In a voice verification system for dividing speech utterances into speech frames and analyzing the frames independently to verify one speaker's voice as compared to another's, the improvement therewith of a method for verifying a speaker's voice by subjecting the speaker to an enrollment test for verification based upon the premise that speech utterances are a fixed set of words arranged in a randomized order, comprising the steps of:

Causing said speaker to enroll by uttering from a vocabulary a predetermined number of combined words each word indicative of a number between one to nine and at least one bridging word "ti" *(user enrollment of a voice password comprising a string of digits, Col. 11, Lines 45-55. Also, it would have been obvious to one of ordinary skill in the art, at the time of invention that a model set (vocabulary) relating to a voice password would contain four, six seven, nine, and in the case of a password such as "470" or "four seventy", ti, since a password-based speaker verification system would commonly utilize number-related vocabulary words in order to recognize numbers in a password sequence).*

Adapting the parameters of a set of word models for said vocabulary words based upon input speech data to provide adapted word models *(creating speaker dependent word models, Col. 8, Lines 40-43).*

Vysotsky does not specifically suggest a feature vector as a concatenation of state mean vectors, however it would have been obvious to one of ordinary skill in the art, at the time of invention, to concatenate the mean vectors of the adapted HMMs, as is well known in the art, in order to create a feature vector related to an entire password sequence for speaker verification

which can provide instant recognition of an entire password at once, instead of recognition of individual password digits in sequence.

With respect to **Claim 11**, Vysotsky further discloses:

Comparing said feature vector obtained from said enrollment with a feature vector obtained from a speech test to determine the identity of said one speaker voice *(voice verification through comparison of feature vectors corresponding to a voice password to identify either a true or impostor speaker, Col. 11, Lines 45-63)*.

With respect to **Claim 12**, Vysotsky further recites:

Feature comparison is implemented by subjecting said vectors to a weighted Euclidean Distance computation *(Euclidean distance used in speech recognition, Col. 8, Lines 44-47)*.

With respect to **Claim 13**, Vysotsky further discloses:

The words are indicative of numbers, namely, "four", "six", "seven", "nine", and "ti" *(voice password for user verification as a string of digits comprising a word, Col. 11, Lines 45-55)*.

It also would have been obvious to one of ordinary skill in the art, at the time of invention that a model set (vocabulary) relating to a digit string voice password would contain four, six seven, nine, and in the case of a password such as "470" or "four seventy", ti, since a password-based speaker verification system would commonly utilize number-related vocabulary words in order to recognize numbers in a password sequence.

With respect to **Claim 14**, Vysotsky discloses the speaker verification system featuring speaker enrollment through a voice password and adaptive word models as applied to Claim 10. Vysotsky does not specifically suggest model adaptation implementing a Baum-Welch

algorithm, however it would have been obvious to one of ordinary skill in the art, at the time of invention, to specifically utilize a Baum-Welch algorithm for HMM parameter adaptation since it is a well-known and common means of HMM parameter estimation in the art of speech recognition and has readily available software.

With respect to **Claim 15**, Vysotsky further discloses a feature vector matrix used for comparison to input speech feature vectors for voice identification *(Col. 8, Lines 4-7)*. Also, it would have been obvious to one of ordinary skill in the art, at the time of invention that the dimensionality of this matrix could have a value of 1568, for instance, in a 49X32 or other such matrix configuration, based on desired system settings.

With respect to **Claim 16**, Vysotsky further discloses:

Forming said feature vector for each speaker using the difference in vectors between a first and second speaker channel *(speaker reference model adapted and thus formed according to changes in speaker and channel coupling, Col. 11, Line 64- Col. 12, Line 1)*.

With respect to **Claim 17**, Vysotsky teaches the speaker verification system featuring speaker enrollment through a voice password and adaptive word models responsive to changes between speaker channels as applied to Claim 16. Vysotsky does not specifically suggest the approximation of speech with white noise channel differences in deriving speaker features as recited in Claim 17, however it would have been obvious to one of ordinary skill in the art, at the time of invention, to include white noise approximation in speech features, since white noise is common to telephone communication channels, and thus, should be included within the speaker feature vectors modeled from speech inputs to the communication channels to better approximate their expected characteristics.

Conclusion

10. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure:

- Carey et al *(U.S. Patent: 5,526,465)*- teaches a speaker verification system featuring HMMs formed from speaker feature vectors, verification means through a voice password implementing HMMs related to numerical digits and built using a Baum-Welch algorithm, and speaker enrollment.
- Gardner et al *(U.S. Patent: 5,754,977)*- discloses a system for speaker verification that identifies a speaker using a distance comparison.
- Naylor et al (U.S. Patent: 5,806,034)- teaches a speech recognition system containing trained HMMs for speaker recognition, which are formed using a Baum-Welch algorithm and further concatenated for each training utterance. Also, a speaker is identified through a distance comparison of speech features.
- Barclay et al *(U.S. Patent: 5,960,399)*- discloses a speaker verification method that provides for feature extraction and HMM adaptation through a Baum-Welch algorithm in the verification process.
- Naito et al *(U.S. Patent: 5,983,178)*- teaches a speaker clustering apparatus implementing feature extraction, HMM model adaptation through a Baum-Welch algorithm, feature comparison through a Euclidean distance computation, and phoneme concatenation in speaker identification.

11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to James S. Wozniak whose telephone number is (703) 305-8669 and email is James.Wozniak@uspto.gov. The examiner can normally be reached on Mondays-Fridays, 8:30-4:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Talivaldis Ivars Smits can be reached at (703) 306-3011. The fax/phone number for the Technology Center 2600 where this application is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the technology center receptionist whose telephone number is (703) 306-0377.

James S. Wozniak
2/11/2004

TĀLIVALDIS IVARS ŠMITS
PRIMARY EXAMINER